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Dated 5 March 2004

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1. Your reference — WMO/RA/P200444

2. Patent application number *(The Patent Office will fill in this part)* — 0308283.1 — ~~10 APR 2003~~

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Winston David Fink
25 North Rand Road
Beyers Park
Boksberg
Gauteng, Republic of South Africa

Patents ADP number *(if you know it)* 86080440 01

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention — Manufacture of carbonyl sulphide

5. Name of your agent *(if you have one)* — Urquhart-Dykes & Lord

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Tower House
Merrion Way
Leeds
LS2 8PA

Urquhart-Dykes & Lord
Tower North Central
Merrion Way
LEEDS
LS2 8PA

Global charge

Patents ADP number *(if you know it)* 16440 04

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

No

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Patents Form 1/77

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Continuation sheets of this form	0
Description	7
Claim(s)	1 DL
Abstract	0
Drawing(s)	3

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	Yes
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date 10-4-03

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr William M Orr
0113 245 2388

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DUPLICATE

FIELD OF THE INVENTION

THIS INVENTION relates to the manufacture of carbonyl sulphide which is also known as carbonyl oxysulphide.

BACKGROUND TO THE INVENTION

Carbonyl sulphide, which is usually referred to as "COS", is being used for fumigation of, for example, grain in silos. It is replacing earlier fumigants which are now considered to be ecologically unfriendly.

Commercially, COS is produced in one of two ways. One method involves reacting carbon monoxide with molten sulphur in a reaction vessel. The carbon monoxide is bubbled up through the molten sulphur. Molten sulphur is a dangerous, aggressive substance and hence specialized reaction vessels are required. Furthermore, carbon monoxide is a costly gas. As a consequence of these factors the resultant COS is expensive.

The second production method of which Applicant is aware comprises creating a heated fluidized bed of sulphur in particulate form and reacting it with the carbon monoxide. The sulphur is often in the form of pyrites so that the residue is iron which has a significant sulphur content and is hence not usable as feed stock for a smelting process.

Whilst this method results in a cheaper product than the first method described, the COS which is produced is still expensive.

COS, if produced at a lower cost, would be more widely used for fumigation than it is now and this has important ecological consequences.

Thus the present invention seeks to provide a process of COS production which results in COS that is less expensive than COS produced by current methods.

BRIEF DESCRIPTION OF THE INVENTION

According to the present invention there is provided a process for producing carbonyl sulphide which comprises dissolving sulphur in carbon disulphide and reacting the solution of sulphur in carbon disulphide with carbon monoxide.

The carbon monoxide for the reaction is preferably obtained by reacting carbon dioxide and carbon to produce carbon monoxide.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:-

Figures 1 and 2 illustrate a COS product plant; and

Figure 3 illustrates a detail of the plant.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring firstly to Figure 1, carbon in the form of, for example, carbon black is fed along a line 10 to a reactor 12. Carbon dioxide is fed to the reactor along a line 14. The reaction in the reactor 12 is:

$$CO_2 + C \rightarrow 2CO$$

A line 16 leads from the reactor 12 to a heat exchanger 18 in which the carbon monoxide produced is cooled.

Reference numeral 20 generally designates means for supplying sulphur dissolved in carbon disulphide. Sulphur is fed along a line 22 to a vessel 24 and liquid carbon disulphide is fed to the vessel along a line 26. The vessel is diagrammatically shown as having a paddle 28 for stirring the liquid carbon disulphide to cause the solid sulphur to dissolve in it. The liquid which flows out of the vessel 24 is at approximately 25°C.

A three stage reaction vessel 30, 32, 34 is provided for reacting the dissolved sulphur with the carbon monoxide flowing in from the reactor 12. The first stage reaction vessel 30 has an inlet 36 to which a line 38 leads from the heat exchanger 18. The first stage reaction vessel 30 has a further inlet 40 to which a line 42 connects, the line 42 leading from the vessel 24 to the reaction vessel 30.

The arrangement of the inlets 36 and 40 is shown in Figure 3 which also illustrates an oil cooling jacket 44. The diameter of the flow path increases downstream of the inlet 40.

Pipes 48 and 50 connect the three stages of the reaction vessels to one another in series.

Liquid coolant is pumped into a cooling jacket 52 of the third stage 34 along a pipe 54. From the jacket 52 the coolant flows along a further pipe 56 to a jacket 58 of the second stage 32. A still further pipe 60 connects the jacket 52 to the jacket 44.

From the stage 34 a mixture of gaseous COS and gaseous carbon disulphide flows to a further two stage reactor 62, 64 connected in series with one another by a pipe 66.

The stages 62, 64 are identical to the stages 30, 32, 34 and include jackets through which coolant is pumped. The coolant inlet pipe is designated 67.

The main reaction in the stages 30, 32, 34,62, 64 is:

$$CO + S \rightarrow COS$$

Subsidiary reactions are:

$$C + 2S \rightarrow CS_2$$

$$CS_2 + CO_2 \rightarrow 2COS$$

The liquid coolant circuit is shown in chain dotted lines in Figure 1 and includes the pipes 48, 50, 54, 56, 60 and 66. It also includes a pipe 68 which leads to the heat exchanger 18.

Return coolant pipes are shown at 70, 72 and 74 which join at 76 and continue as a single pipe 78 to a heat exchanger 80 which is used to dispose of excess heat. From the heat exchanger 80 a pipe 82 leads to a sump 84 in which solids settle out. A further pipe 86 leads from the sump 84 to a coolant storage tank 88 to which, on expansion of the coolant when it is heated, excess coolant flows.

An outlet pipe 92 leads from the sump 84 and constitutes a manifold which supplies coolant to the heat exchanger 18 and the reaction vessel stages 30, 32, 34, 62, 64.

The outlet of the last reactor stage 64 is designated 94 and a line 96 connected to it leads to a condenser 98 (see Figure 2). The condenser 98 has an outlet 100 for the gaseous fraction and an outlet 102 for the liquid fraction. The outlets 100 and 102 are connected to a distillation column 104.

In the column 104 the gaseous fraction, which consists mainly of COS, rises and the liquid fraction, consisting mainly of liquid carbon disulphide, runs down

the column 104.

The liquid which flows from the column 104 flows along a line 106 to a reboiler 108 fed with hot liquid along a pipe 110. The return heating liquid pipe is shown at 112. COS in the reheated liquid which is returned to the column 104 rises in the column and is recovered.

A liquid level detector is provided in the column 104. When this detects that the top surface of the carbon disulphide in the column 104 has reached a predetermined level, liquid carbon disulphide is diverted to a cooler 114, 116 before reaching a storage tank 118.

Carbon disulphide in the tank 118 is eventually returned to the line 26 and recycled.

A cooling water circuit for the cooling stages 114, 116 is shown in dashed lines, this also providing chilled water for the condenser 98. A water chiller of conventional type is shown at 120.

The gaseous fraction which flows out of the column 100 comprises carbonyl sulphide and carbon disulphide and passes through two air refrigeration stages 122, 124. In the first stage cooling takes place to a temperature above that at which carbonyl sulphide liquifies but below that at which carbon disulphide liquifies. The liquified carbon disulphide is returned to the column 104. In the

second stage the carbonyl sulphide is cooled until it liquifies. From the second stage liquid COS is fed along a line 126 to a tank 128 and other carbon gases, such as carbon dioxide and carbon monoxide, are vented through an outlet 130.

CLAIMS:

1. A process for producing carbonyl sulphide which comprises dissolving sulphur in carbon disulphide and reacting the solution of sulphur in carbon disulphide with carbon monoxide.

2. A process as claimed in claim 1 and including the step of reacting carbon dioxide and carbon to provide carbon monoxide for reaction with the dissolved sulphur.

3. A process as claimed in claim 1 or 2 and including the step of feeding the carbonyl sulphide produced and the carbon disulphide carrier to a distillation column to separate liquid carbon disulphide from gaseous carbonyl sulphide.

4. A process as claimed in claim 3 and including the step of further separating the carbonyl sulphide produced from the carbonyl disulphide carrier by cooling the mixture to a temperature above that at which liquification of carbonyl sulphide occurs and below that at which liquification of carbon disulphide occurs.

5. A process as claimed in claim 4 and including the step of liquefying the carbonyl sulphide after removal of the carbon disulphide.

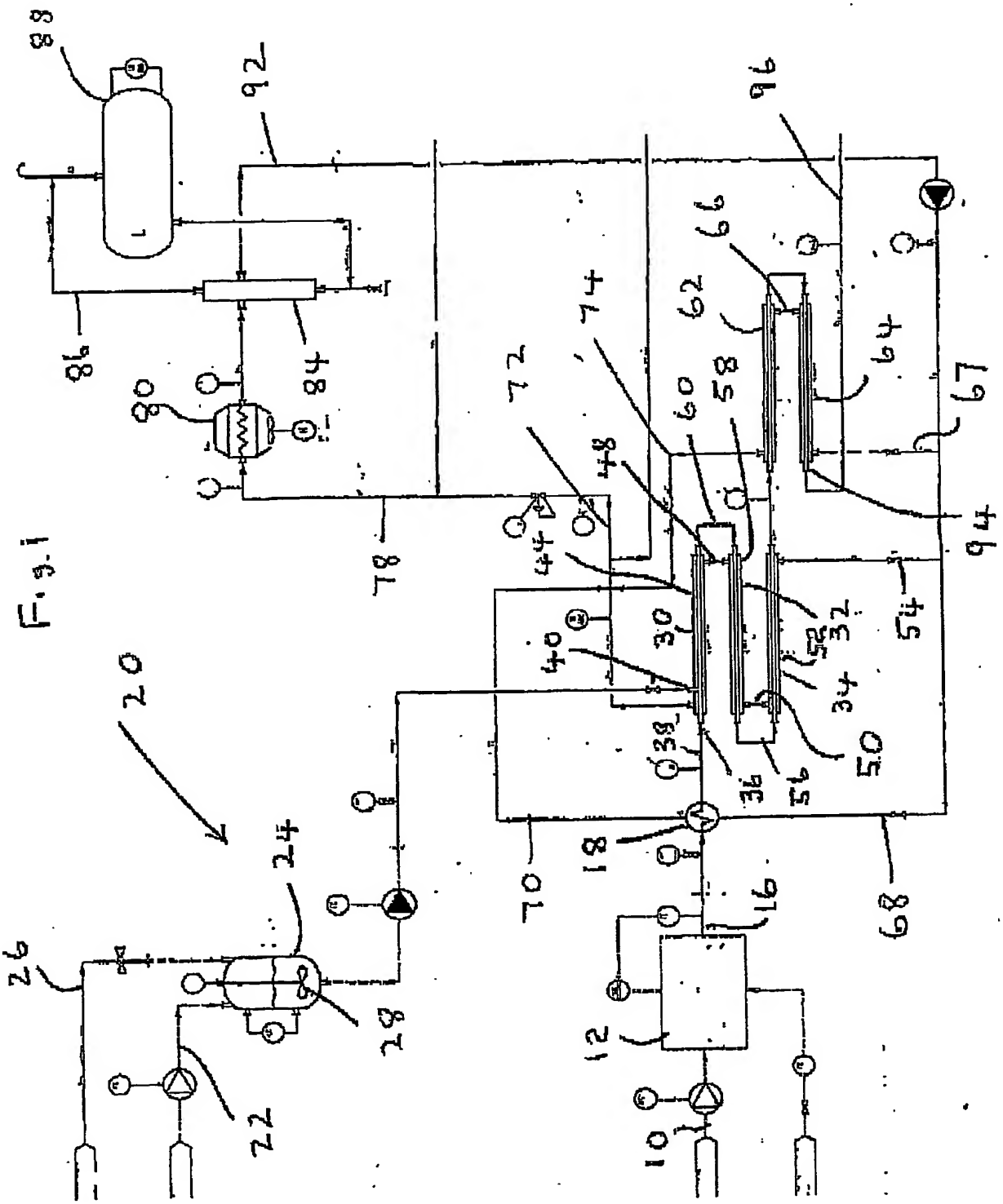
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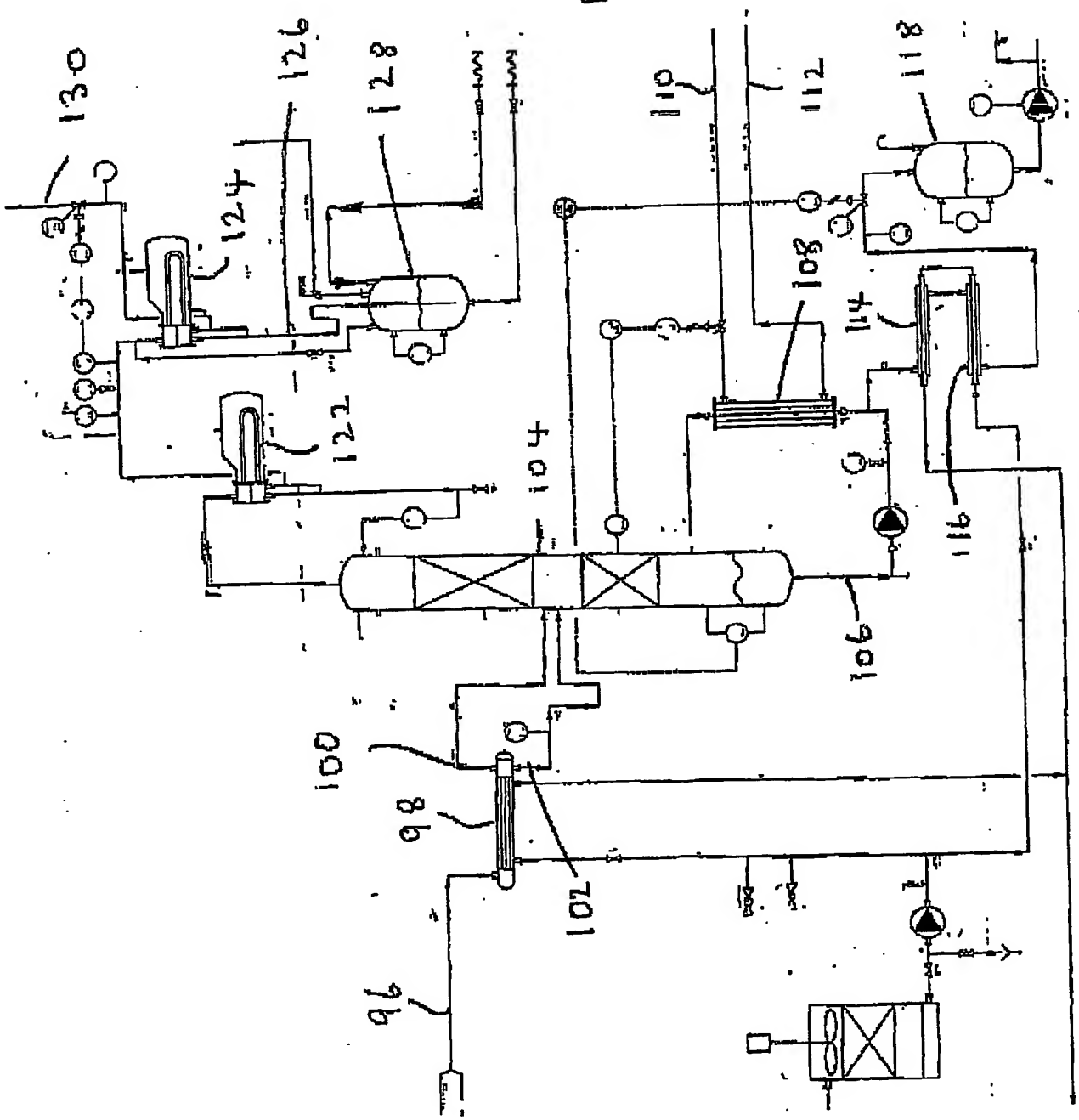
Fig. 1

Fig 2



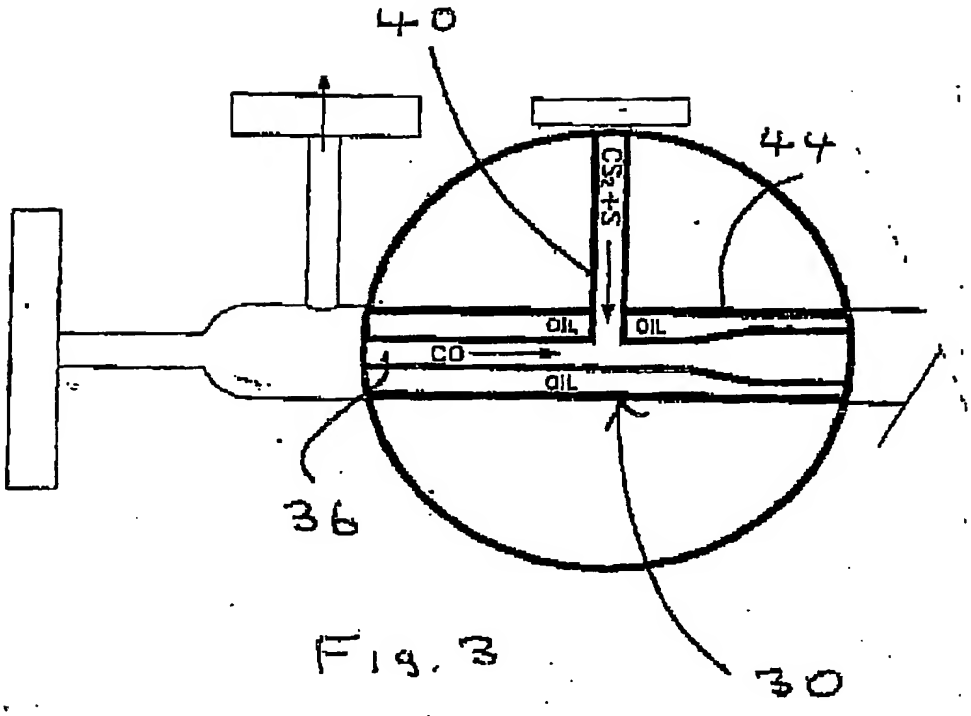


Fig. 3

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